THE ARRANGEMENT OF THE SUPRA-CEREBRAL VEINS IN MAN, AS BEARING ON HILL'S THEORY OF A DEVELOPMENTAL ROTATION OF THE BRAIN.[1]

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ALTHOUGH this theory of Hill was first published in 1885, the short sketch appended to his translation of Obersteiner (1890) will doubtless serve to gain for it much more general attention. As it has not, however, been worked out much beyond the stage of an attractive suggestion it may be in order to point out any other facts bearing thereon. In the first place his view is hardly described in sufficient detail to make it in all respects clear, and at best should not be taken too literally as regards minor points. He compares the form of the perfected mammalian brain, meaning, of course, each hemicerebrum, to that of a ram's horn or of a loop or kink. It might quite as well be likened to one turn of a spiral. To comprehend this more clearly, as applied to the brain, we should remember that a structure may simply enlarge without otherwise changing its internal or external relations, or it may, without change in volume, undergo any variation in shape; or finally, as is the view in the present case, it may both enlarge in volume and double or become twisted on itself. That the human cerebrum, as compared with that of lower orders, has expanded in certain parts and directions is, of course, an old observation. But, besides this, the claim is now made that the primarily straight brain has in its growth become reflected and curved on itself in such a way that it may be likened in general outline to a ram's horn, the apex of the temporal lobe representing the tip of the horn.

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[1] Read before the Association of American Anatomists at the Washington Congress, September 24th, 1891.

For the present purpose it is not necessary to enter into the particulars of the theory or the arguments advanced, further than to say that he makes no use of local circulatory peculiarities in support of his position.

For instance, the distribution of the precerebral artery is very suggestive of a reflected field. This is noticeable in a general way in Duret's plates (*Arch. de Physiolog.*, Paris, 1874), but is more strikingly apparent in my recent ones (*Wood's Reference Handbook*, Vol. viii., N. Y., 1889). As these last were simply drawn to fact without thought of theory, they offer the better evidence. It is also noticeable in dissecting out these precerebral branches, that they run in juxtaposition to the parent stem for a surprising distance before glancing off to their respective fields.

But it is imaginable that the arteries, since they are more under the influence of an internal directing pressure, would more rapidly conform and adapt themselves to any new position, than would the veins with their interior pressure almost *nil.* Hence, from the veins, if from either, might we most naturally expect evidence relating to this point; and of the veins, those that from this theory would be subjected to the greatest displacement, viz., the supracerebrals. These lie along part of the greater curvature of this supposed spiral.

Except very casually Hill does not consider whether, in this transformation, any rôle is played by the enveloping membranes. However, the pia, being so abundantly connected to the brain by innumerable arterioles and veinules and also so involved by folds in the fissures, must naturally be carried along to the same extent as the apposed cerebral tissue. The more external membranes, on the contrary, are but slightly connected with the brain, and as in any such twisting of the brain its envelopes must naturally, for their own part, perform a purely passive rôle, it follows that the dura and skull are not carried along *in toto*, but simply conform by expansion or contraction to the growth-demands of the subjacent brain proper. Hence at the only points, exclusive of the base, where there are any connections between dura and pia some results of the tension produced by the dragging of the one on the other would be probable. The main connections of this kind are again the supracerebral veins.

On this point part of the evidence to be quoted was published a full year before the first appearance of Hill's proposition, and hence may safely be considered free from any bias of previous knowledge. (Browning, *Veins of the Brain*, Brooklyn, 1884, p. 14–15): "It was long since observed that the more anterior supracerebrals take a course very nearly at right angles to the sinus, and that the posterior ones take more and more an oblique course, to such an extent that the most posterior ones must run forward a distance of 3 to 4 ctm. Here they terminate in the sinus with a very acute angle, against the blood current. The vein coming from the convexity makes at the edge of the longitudinal fissure, or somewhat further out and back in the pia, the necessary angle in order to approach the sinus as described. It then runs a short distance forward before leaving the pia. . . . The anterior supracerebrals, more often than the posterior ones, spring over from the pia to the dura at some distance 1 to 3 or 4 ctm. laterally from the sinus.[2]

The posterior ones reach the side of the sinus, and the most posterior ones even curve forward before leaving the pia, but the distance from this point to that where they empty into the sinus is at least equal to that in the varying anterior ones." Page 15: "The anterior (supracerebral) veins empty above or at the side of the sinus, comparatively unhindered, as though they came straight from the dura. The veins further back, however, discharge more and more at the side and bottom of the sinus, and those farthest back empty almost without exception at the bottom. Many of the latter, indeed, must take an upward course through the falx cerebri and traverse a considerable distance before they reach the lowest part of the sinus." On this last matter Trolard had previously made a similar observation. The above quotations sufficiently indicate the facts which, it is believed, have some relation to the rotation theory.

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[2] This further progressive distinction between the anterior and the posterior supracerebrals has since been again and more fully studied by Mittenzweig, (1889).

Page 54:—"*Development.* If one bears in mind that the brain in its growth doubles, so to speak, over backward and elongates somewhat, it is easy to see that from this . . . the brain would carry the pia with its veins backwards, the posterior ones a considerable distance, the anterior ones little or none at all. (Foot note.) This can be prettily illustrated with a column of soft potter's clay. A stout cord runs straight along one side from end to end, representing the sinus longitudinalis; small cross-strings firmly fastened to the large one at equal distances, a little pressed into the clay, but with their ends free, represent the supracerebrals. If now we fix one end of the column and cord, and then bend the other end of the column in a direction away from the cord, the latter will be seen to no longer reach the whole length of the now convex side; while of the cross-strings, the first are about as before, rectangular to the sinus; those farther back have been so pulled forward and down that they can be followed some distance beside the main cord before they pass out around the column. This corresponds closely to what seems to have occurred in man."

Page 55:—"The appearance on one small fœtal brain seemed to substantiate this, *i. e.*, the posterior veins did not stand so oblique to the sinus as in the brains of adults." This is very conclusively shown by the illustrations in the more recent work of E. Hédon (*Étude Anatomique sur la Circulation Veineuse de l'Encephale*, Paris, 1888). Plate V., fig. 1, from a human fœtus of 3½ months, shows no indication of this angular attitude of the posterior supracerebral veins. Plate V., fig. 2, from a fœtus of 6½ or 7 months, gives some evidence of this arrangement, whilst in Plate VI., fig. E., the usual position of these veins in the human adult is outlined and can be compared with the immature forms.

If it were possible to determine the proper size of column, calculations or experiments might be made with it and the results compared with measurements from a number of adult human beings *in situ*, with a view to determine mathematically how far the argument from the veins bears out the theory.

Further, it is probable that the closing up after fœtal, or at latest during infantile life, of the prolongation of the longitudinal sinus through the foramen cæcum, may be explained by the same retracting action of the supracerebrals at their junction with the said sinus, especially as the maximum tension, so far as the sinus line is concerned, would be exerted at this point.

Although the evidence from the vascular arrangements as here cited only applies to a portion of the cerebrum, it at least so far corroborates the rotatory or spiral theory, or at least adds interest to it as a working theory. Moreover, this is evidence that can readily be followed by a comparison of human brains at different stages of growth.

CEREBRAL HÆMORRHAGE.

Dr. Mendel (Medical Age, July 25, 1891), after some researches to determine why cerebral hæmorrhage generally takes place in the substance of the corpus striatum and optic thalamus, advances the following: The arteries distributed to the medullary substance and central ganglia are terminal and do not anastomose with the neighboring vessels, while the arteries of the cortex present numerous anastomoses. If arterial tension be increased, the pressure becomes much greater in the vessels of the corpus striatum than in those of the cortex. Augmentation of pressure in the arterial system produces elongation of the artery of the corpus striatum and causes little lateral dilatations. Little by little, if these variations of pressure are repeated, the muscular tunica atrophies, the dilatations remain permanent and the slightest exaggeration of pressure causes the vessel to give way. In treatment the ice-cap is irrational. On the one hand, it is impossible the action of cold can penetrate the interior of the cranium to the source of the hæmorrhage; on the other, if it exercises its influence on the cortex, it determines a contraction of those vessels which can best drive the blood towards the central parts, and still more increases the blood-pressure there. The only rational treatment is absolute repose of the body, with the head raised. A. F.